

(19)



Europäisches Patentamt  
European Patent Office  
Office européen des brevets



(11)

EP 0 793 031 A1

(12)

## EUROPEAN PATENT APPLICATION

(43) Date of publication:  
03.09.1997 Bulletin 1997/36

(51) Int. Cl.<sup>6</sup>: F16D 7/00, F16D 3/76

(21) Application number: 97103250.3

(22) Date of filing: 27.02.1997

(84) Designated Contracting States:  
DE GB IT

(30) Priority: 29.02.1996 JP 43498/96  
06.01.1997 JP 332/97

(71) Applicant: DENSO CORPORATION  
Kariya-City Aichi-Pref. 448 (JP)

(72) Inventors:  
• Kishibuchi, Akira  
Kariya-City, Aichi-Pref. 448 (JP)

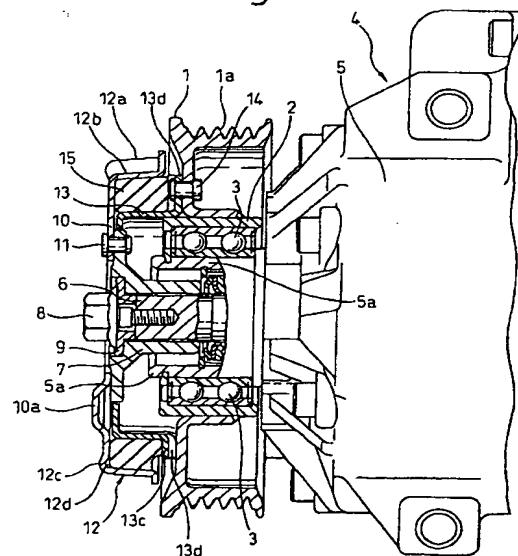
• Okuda, Kiyomi  
Kariya-City, Aichi-Pref. 448 (JP)  
• Takahara, Yasuo  
Kariya-City, Aichi-Pref. 448 (JP)

(74) Representative: Klingseisen, Franz, Dipl.-Ing. et al  
Patentanwälte,  
Dr. F. Zumstein,  
Dipl.-Ing. F. Klingseisen,  
Postfach 10 15 61  
80089 München (DE)

### (54) A device for transmitting rotational power

(57) A device for transmitting a rotational power from an automobile engine to a compressor (4) for use in an automobile air conditioning system is provided. The device includes a pulley (1), which is supported on a housing (5) of the compressor (4) for rotation, for receiving a rotational power from the automobile engine, and a hub (7) connected to the drive shaft (6). At least one elastic member (15) which defines outer and inner peripheral surfaces is provided. A first holder member (12) is provided along the outer periphery of the hub (10) for holding the elastic member (15). A second holder member (13) which is connected to the pulley (1) is provided for holding the elastic member (15). The first and second holder members (12,13) radially cooperate with each other to circumferentially hold the elastic member (15) during normal operation to transmit the rotation. The first and second holder members (12,13) are disconnected by deformation of the at least one elastic member (15) when a relative rotation between the pulley (1) and drive shaft (6) occurs. The connecting member (15) and the first holder member (12) define a relief clearance (12c) therebetween for facilitating the deformation of the at least one connecting member (15).

Fig. 1



EP 0 793 031 A1

**Description****Cross-reference to Related Application**

Reference is made to commonly assigned copending Application No. 08/527,821, entitled "A DEVICE FOR TRANSMITTING ROTATIONAL POWER", filed on September 13, 1995.

**BACKGROUND OF THE INVENTION****1. Field of the Invention**

The invention relates to a device for transmitting rotational power from a rotational power source such as an automobile engine to a rotational driven device such as a refrigerant compressor for an air conditioner. The device can rotationally separate the driven device from the rotational power source when the torque transmitted exceeds a predetermined value, that is, the device functions as a torque limiter.

**2. Description of the Related Art**

Japanese Examined Utility Model Publication (Kokoku) No. 6-141104 describes a rotational power transmission device which has a torque limiting function. The device comprises a drive member which is connected to the crank shaft of an automobile engine through a belt, a driven member which is connected to a shaft of a compressor, and a connecting mechanism between the drive and driven members, which mechanism is provided with levers of rigid material and a spring which is made of a metallic material, in the form of a ring, which engages the levers. The drive member is rotationally connected to the driven member by the engagement between the levers and the spring.

When the drive shaft of the compressor is locked, by a failure such as seizing in the compressor and the torque on the connecting mechanism exceeds a predetermined level, the drive levers apply a force on the spring to deform the spring. The deformation of the spring disconnects the engagement between the levers and the spring.

The prior art rotational power transmission device, however, cannot absorb a fluctuation in the torque applied to the device since a metallic spring is used to connect the drive member to the driven member. Therefore, in order to absorb a fluctuation in torque, an additional device must be provided, which increases the production cost.

Further, in an automobile, a driven device, such as a compressor is generally driven by a rotational power transmitted from a crank pulley of the automobile engine through a belt. Therefore, in order to protect the belt from damage, it is desired a relatively low shut off torque, for example, 60 Nm, at which the rotational power transmitting device disconnects or disengages.

**SUMMARY OF THE INVENTION**

The invention is directed to solve the above mentioned prior art problems, and the objective of the invention is to provide a rotational power transmission device with a torque limiting function which can absorb a fluctuation in torque to be transmitted.

Further, the objective of the invention is to provide a rotational power transmission device with a relatively low level shut off torque, which can be used to transmit a rotational power from an automobile engine to an driven device, such as a compressor for compressing a refrigerant in an automobile air conditioning system, through a belt.

Further, the objective of the invention is to improve a rotational power transmission device which can function to absorb the fluctuation in torque transmitted and to shut off the transmission of a rotational power when the torque on the rotational power transmission device exceeds a predetermined value, that is an actuation torque, in which an improvement is made to allow setting of the resonance frequency of the rotational transmission device suitably for a device to which the rotational power transmission device is applied while the actuation torque is kept to a constant value.

According to the invention a device for transmitting a rotational power from an automobile engine to a compressor for use in an automobile air conditioning system is provided. The compressor includes a housing and a drive shaft which extends along the axis of the housing. The drive shaft is supported by a bearing on the housing for rotation about the axis of the housing. The device for transmitting a rotational power comprises a pulley, which is supported by a bearing on the housing for rotation about the axis of the housing, for receiving a rotational power from the automobile engine through a V-belt extending between the pulley and the automobile engine, a hub connected to the drive shaft, and means for rotationally connecting the pulley and hub.

The connecting means comprises at least one elastic member with defined outer and inner peripheral surfaces. A first holder member is provided along the outer periphery of the hub for holding the at least one elastic member at the radially outer periphery of the at least one elastic member. A second holder member which is connected to the pulley is provided for holding the at least one elastic member at the radially inner periphery of the at least one elastic member.

The first and second holder members radially cooperate with each other to circumferentially hold the at least one elastic member during normal operation to transmit the rotation. The first and second holder members are disconnected by the deformation of the at least one elastic member when a relative rotation between the pulley and drive shaft occurs. The at least one connecting member and the first holder member defines a relief clearance therebetween for facilitating the deformation of the at least one connecting member when a relative rotation between the pulley and drive shaft

occurs.

According to one feature of the invention, the first holder member defines a peripheral surface which is substantially complementary to the outer peripheral surface of the elastic member. The second holder member defines a peripheral surface which is substantially complementary to the inner peripheral surface of the elastic member. The first and second holder members radially cooperate with each other to circumferentially hold the at least one elastic member during normal operation to transmit the rotation.

According to another feature of the invention, at least one of the first and second holder members defines a peripheral surface with a plurality of outwardly convex and concave portions alternatively arranged along at least one of the outer and the inner periphery.

According to another feature of the invention, the at least one elastic member is substantially made into a ring shape, and includes a base portion substantially in the form of a ring, and a peripheral surface with a plurality of outwardly convex and concave portions alternatively arranged along at least one of the outer and the inner periphery substantially to complement to the peripheral configuration of at least one of the first and second holder members. The outwardly convex portions have an axial length longer than that of the base portion, shorter than that of the base portion, or equal to that of the base portion. Selecting the axial length of the outwardly convex portions relative to that of the base portion allows the rotational power transmission device to perform the desired torque limiter and vibration absorption functions.

#### DESCRIPTION OF THE DRAWINGS

These and other objects and advantages and further description will now be discussed in connection with the drawings in which:

Figure 1 is a partial section, along line I - I in Figure 2, of the device for transmitting rotational power according to an embodiment of the invention in which the device is mounted to a drive shaft of a compressor for use in an automobile air conditioning system;

Figure 2 is a partial front view of the device of Figure 1 in which the elastic connection member is indicated by oblique lines to indicate clearly;

Figure 3A is a front view of the second holder member according to the embodiment of Figure 1;

Figure 3B is a side end view of the second holder member along line III - III in Figure 3A;

Figure 4 is a front view of the elastic member according to the embodiment of Figure 1;

Figure 5 illustrates a system diagram of devices on an automobile engine to which the device of the invention is applied;

Figure 6 illustrates the characteristics of the torque fluctuation absorption according to the invention;

Figure 7A is a partial front view of the elastic connection member according to an embodiment of the invention;

Figure 7B is a side end view of the elastic connection member shown in Figure 7A along VII - VII; Figure 8 is an illustration similar to Figure 6 for explaining the change in characteristics according to the configurations of the elastic connection member;

Figure 9A is a partial front view similar to Figure 7A according to another embodiment of the invention;

Figure 9B is a side end view of the elastic connection member shown in Figure 9A along IX - IX;

Figure 10A is a partial front view similar to Figure 7A according to another embodiment of the invention;

Figure 10B is a side end view of the elastic connection member shown in Figure 10A along X - X;

Figure 11A is a front view of the second holder member according to another embodiment, in which four elastic connection members substantially in the form of a sector are indicated by oblique lines;

Figure 11B is a side end view of the second holder member with the connection members along line XI - XI in Figure 11A;

Figure 12A is a front view of the second holder member of Figures 11A and 11B;

Figure 12B is side end view of the second holder member along line XII - XII in Figure 12A;

Figure 13 is a front view similar to Figure 2 of the embodiment of Figures 11A - 12B; and

Figure 14 is a partial section similar to Figure 1 along line XIV - XIV in Figure 13.

#### DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to Figures 1 and 2, a rotational power transmission device according to the first embodiment of the invention comprises a pulley 1 for receiving a rotational driving power from an automobile engine (not shown) as a rotational power source. The pulley 1 includes a rim 1a with a plurality of V-shaped grooves adapted to engage V-shaped belts 21 (Figure 5), and is operationally connected to a crank shaft (Figure 5) of the automobile engine through V-shaped belts 21.

Figure 5 illustrates an example of a drive system for devices on the automobile engine. The system includes a crank pulley 20 which is connected to the crank shaft of the automobile engine. The belts 21 extend from the crank pulley 20 via water pump pulley 22 of a water pump in a cooling system of the automobile engine, an alternator pulley 23 of an alternator for charging a battery, a hydraulic pump pulley 24 of a hydraulic pump for a power steering system, and the pulley 1. Tension pulleys or idle pulley 25, 26 and 27 are provided for applying a tension to the belt 21.

Referring to Figures 1 and 2 again, the pulley 1 is

connected to a rotor 2 by an appropriate connecting method such as welding. The rotor 2 is mounted on a cylindrical support 5a, which outwardly extends from a front housing 5 of a compressor 4 as a driven device, by a bearing 3 for rotation. The compressor 4 is of a variable displacement type for use in an automobile air conditioning system (not shown). The compressor 4 comprises a front housing 5a and a rear housing (not shown) connected to each other to form a cylinder block including a plurality of parallel cylinder bores disposed about the axis. A drive shaft 6 extends through the cylinder block along the axis. Connected to the drive shaft 6 through a swash plate (not shown) are reciprocating pistons (not shown) to be provided within the cylinder bores. Changing the angle of the swash plate changes the displacement of the compressor 4 within a range of 0 - 100% continuously. Using a variable displacement type compressor avoids the necessity of an electromagnetic clutch for an on/off operation of the compressor. A detailed description regarding the compressor 4 and the automobile air conditioning system is disclosed in the copending application No. 08/527,821, which is incorporated herein by reference, thus no further description is made to avoid redundancy.

The rotational power transmission device further comprises a first hub 7, an end plate 9 and a bolt 8 threadly connected to the end of the drive shaft 6. In particular, the first hub 7 is connected to the drive shaft 6 through a spline connection (not shown) provided on the outer surface of the drive shaft 6 and the inner surface of the first hub 7 to prevent the relative rotation therebetween.

Connected to the first hub 7 by rivets 11 is a second hub 10 which is formed into a ring plate with a cylindrical wall 12 extending along the outer periphery of the second hub 10. The cylindrical wall 12 provides a first holder member. The wall 12 includes a plurality of outwardly convex and concave portions 12a and 12b alternately arranged along the periphery of the second hub 10. The convex and concave portions 12a and 12b provide an engagement force in the peripheral direction as described hereinafter.

A holder member 13, which provides a second holder member, substantially in the form of a ring, is provided to hold an elastic connection member 15 by cooperation with the cylindrical wall 12 of the second hub 10. The holder member 13, as shown in Figures 3A and 3B, also includes a plurality of outwardly convex and concave portions 13a and 13b alternatively arranged along its periphery. The holder member 13 further includes clamping portions 13c, for axially clamping the elastic connection member 15 by cooperation with the second hub 10, and flange portions 13d. The clamping portions 13c substantially have an L shape section which includes axial and radial portions. The flange portions 13d also substantially have an L shape section with axial and radial portions. The axial portions of the flange portions 13d extend longer than those of the clamping portions 13c. The flange portions 13d include

through holes 13e into which rivets 14 are fitted to mount the holder member 13 to the pulley 1.

The connection member 15 is substantially formed into a ring, which includes a plurality of outwardly convex and concave portions 15a and 15b alternatively arranged along its periphery. The connection member 15 is preferably made of an elastic material, which can transfer a torque and absorb a variation in the torque, within a temperature range for use in an automobile (for example, -30 to 120 Celsius degrees), such as a rubber material, preferably, chlorinated butyl rubber, acrylonitrile-butadien rubber or ethylene-propylene rubber. In Figure 2, the connection member 15 is indicated by oblique lines.

During assembly, the connection member 15 is clamped between the clamping portions 13c or the holder member 13 and the second hub 10 so that the outwardly convex and concave portions of the connection member 15 are mated to those of the wall 12 of the second hub 10 and of the holder member 13. The radial portions of the clamping portions 13c prevent the connection member 15 from moving in the axial direction. The difference, in the axial length, between the flange portions 13d and the clamping portions 13c of the holder member 13 allows the connection member 15 to be axially separate from the outer end face of the pulley 1, which reduces the contamination on the connection member 15 due to oil from the compressor 4.

The thickness of the connection member 15 is slightly larger than the distance between the second hub 10 and the clamping portions 13c of the holder member 13. Thus, the connection member 15 is pressed therebetween, when assembled, to ensure the engagement with the second hub 10 and the holder member 13 through the convex and concave portions. The positive engagement operatively connects the holder member 13 to the second hub 10. Thus, the rotation is transmitted from the pulley 1 to the drive shaft 6 of the compressor 4 through the holder member 13, the connection member 15, the second hub 10 and the first hub 7.

The connection member 15 further includes a plurality of outwardly concave recesses 15c, on the outwardly convex portions 15a, for aiding the deformation of the connection member 15. The cylindrical wall 12 and the recesses 15c define relieving clearances 12c, which facilitate the deformation of the connection member 15. The clearances 12c also functions to relieve the deformation of the connection member 15 during assembling by permitting a portion of the connection member 15 to enter the clearances so that the dimensional tolerance of the parts is compensated for to ensure the predetermined shut off torque. Selecting the size and configuration allows a designer to set a shut off torque at which the connection member 15 deforms to disconnect the rotational power transmission from the holder member 13 to the second hub 10.

The operational function of the embodiment will be described.

The rotation of the crank pulley 20 (Figure 5) of the automobile engine is transmitted to the pulley 1 through the belt 21 (Figure 5). The second hub 10 is rotated through the positive engagement between the connection member 15 and the holder member 13, and the connection member 15 and the wall 12 of the second hub 10. Thus, the drive shaft 6 of the compressor 4 is rotated by the rotating pulley 1 through the holder member 13, the connection member 15 and the wall 10 of the second hub 10.

During the normal operation of the compressor 4, a torque, in general 20 Nm, about the drive shaft 6 is applied to the connection member 15. The elastic connection member 15 can absorb a fluctuation in the torque. With reference to Figure 6, shown is an illustration of the effect of the absorption of the torque fluctuation by the elastic connection member 15 in comparison with the prior art in which metallic springs are used to connect a pulley and a drive shaft of a compressor. In Figure 6, the horizontal line is the rotation of the compressor 4, and the vertical line is the half amplitude of a fluctuation in the torque on the drive shaft 6 of the compressor 4. The torque fluctuation, when the elastic connection member 15 is used, is shown by curve I as a solid line, while the torque fluctuation in the prior art is shown by curve II as a broken line. As shown in Figure 6, the peak of the torque fluctuation is shifted to the lower rotation, and the value of the fluctuation is reduced by the invention, which results in the reduction of the vibration of the compressor.

When the drive shaft 6 is locked due to the failure in the compressor 4 such as seizing, the elastic connection member 15 deforms to disconnect the positive engagement by the convex and concave portions of the connection member 15, of the holder member 13 and the wall 12 of the second hub 10. At this time, the clearances 12c provides a large deformation of the connection member 15 by allowing the deformed portion to enter therein so that the deformation is facilitated.

During the deformation and disconnection of the connection member 15, the rotation of the pulley 1 does not stop, which results in the connection member 54 engaging again. When the failure is slight and the drive shaft 6 is locked temporarily, the engaged connection member 15 can transmit the rotation to the drive shaft 6. Thus, the compressor 4 can operate again automatically. When a significant failure occurs in the compressor 4 and the drive shaft 6 is permanently locked, the wear and tear on the connection member 15 completely separates the drive shaft 6 from the pulley 1. Thus, the failure on belts 21 or the other devices 22, 23 and 24 for the automobile engine is prevented.

With reference to Figures 7A and 10B, three embodiments of the invention regarding the configuration of the elastic connection member 15 are illustrated, in which the similar components are indicated by the same reference numbers in Figures 1 - 3.

The connection member 15 provides a torque limiter function as described above by its deformation. In

particular, the outwardly convex portions 15a which are at the front side of the corresponding clearances 12c relative to the rotational direction are pressed to the corresponding concave portions 12b of the wall 12 so that the convex portions deform to the reward direction to enter the corresponding clearances 12c. At the same time, the outwardly convex portions resist deformation due to the spring constant. Thus, the size and configuration of the outwardly convex portions 15a define the torque limiter function under a spring constant. Further, the volume of the clearances 12c, which is defined by the size and configuration of the outwardly convex portions 15a, also defines the degree of the deformation, which also defines the torque limiter function. On the other hand, a base portion 15e in the form of a ring, which is radially inside of a circle of the envelope, defined by connecting the bottoms of the outwardly concave portions 15b, primarily functions to absorb the fluctuation in the torque.

According to the invention, selecting the axial lengths of the outwardly convex and base portions 15a and 15e, respectively, allows the rotational power transmission device to perform the desired torque limiter and vibration absorption functions. In the embodiment illustrated in Figures 7A and 7B, the axial length L1 of the outwardly convex portions 15a is shorter than the axial length L2 of the base portion 15e. In the embodiment illustrated in Figures 9A and 9B, the axial lengths L1 and L2 are equal to each other while in the embodiment illustrated in Figures 10A and 10B, the axial lengths L1 of the outwardly convex portions 15a is longer than the axial length L2 of the base portion 15e.

Referring to Figure 8, with the length L1 being constant, the increase in the length L2 of the base portion 15e increases the resonant rotational speed of the compressor 4 for the torque fluctuation since the greater the length L2, the greater the torsional spring constant of the base portion 15e while the shut off torque is substantially kept at a value. On the other hand, it may be anticipated that changing the length L1, with the length L2 being constant, changes the shut off torque at which the connection member 15 disengages from the holder member 13 and the wall 12 while the resonance rotational speed of the compressor 4 for the torque fluctuation is substantially kept at a value.

In the aforementioned embodiments, the connection member is mounted by clamping it between the second hub 10, the wall 12 and the holder member 13. However, the connection member can be mounted by adhesively securing to at least one of the wall 12 and the holder member 13. Described below with reference to Figures 11 - 14 is another embodiment of the invention, in which the connection member is adhesively secured to the holder member. The components similar to those in the aforementioned embodiments are indicated by the same reference numbers.

The embodiment shown in Figures 11 - 14 comprises four connection members 15 which are made of an elastic material in the form of sectors, in stead of a

ring as in the aforementioned embodiments, and provided at angular intervals about the axis. Each of the sector connection members 15 includes a base portion 15e, a pair of outwardly convex portions 15a and an outwardly concave portion 15b provided therebetween. The number of the outwardly convex and concave portions 15a and 15b, which are alternatively provided, can be advantageously selected. The outwardly convex and concave portions 15a and 15b cooperate with the corresponding convex and concave portions 12a and 12b as in the aforementioned embodiments.

The sector connection members 15 further include a flap portion 15d which is formed in one piece to the base portion 15e to cooperate with the end face of the holder member 13 for increasing the adhesion bond. There is an adhesive agent applied to the radially inner surface of the base portion 15e and to the hidden surface of the flap portion 15d. The outwardly convex portions 15e include slants 15f. Provided between the slants 15f and the inner surface of the wall 12 are relief clearances 12c which facilitate the deformation of the sector connection members 15, in particular, the deformation of the convex portions 15a.

When the connection members 15 are adhesively secured to the holder member 13, the radially inner surfaces of the connection members and the radially outer surface of the holder member 13 can be provide a plane configuration (not shown) instead of the outwardly convex and concave configuration since they are adhesively secured to each other. In this case, the pulley 1 and the drive shaft 6 of the compressor 4 are operatively disconnectably connected by only the positive engagement between the radially convex and concave configuration between the elastic connecting members 15 and the wall 12 of the second hub 10.

Further, the connection members 15 can be adhesively secured to the wall 12 instead of the holder member 13. In this case, the radially outer surfaces of the connection members and the radially inner surface of the wall 12 can be provide a plane configuration (not shown) instead of the outwardly convex and concave configuration since they are adhesively secured to each other.

In the aforementioned embodiments shown in Figures 1 -14, the holder member 13 is connected to the pulley 1 to engage the connection member(s) 15 at the radially inner periphery of the connection member(s) 15, and the wall 12 of the second hub 10 is connected to the first hub 9 so that the wall 12 engage the connection member(s) 15 at the radially outer periphery of the connection member(s) 15. However, the wall 12 and the holder member 13 can be provided vice versa, that is, the wall 12 and the holder member 13 can be provided to engage the connection member(s) 15 at the radially outer and inner periphery of the connection member(s) 15, respectively.

It will also be understood by those skilled in the art that the foregoing description is a preferred embodiment of the disclosed device and that various changes and

modifications may be made without departing from the spirit and scope of the invention.

### Claims

1. A device for transmitting a rotational power from an automobile engine to a compressor for use in an automobile air conditioning system, the compressor including a housing and a drive shaft extending along the axis of the housing, the drive shaft being supported by a bearing on the housing for rotation about the axis of the housing, the device for transmitting a rotational power comprising:
  - a pulley supported by a bearing on the housing for rotation about the axis of the housing, for receiving a rotational power from the automobile engine through a V-belt extending between the pulley and the automobile engine;
  - a hub connected to the drive shaft;
  - means for rotationally connecting the pulley and hub, the connecting means comprising:
    - at least one elastic member with defined outer and inner peripheral surfaces;
    - a first holder member, defined along the outer periphery of the hub, for holding the at least one elastic member at the radially outer periphery of the at least one elastic member; and
    - a second holder member, connected to the pulley, for holding the at least one elastic member at the radially inner periphery of the at least one elastic member;
    - the first and second holder members radially cooperating with each other to circumferentially hold the at least one elastic member during normal operation to transmit the rotation, and being disconnected by the deformation of the at least one elastic member when a relative rotation between the pulley and drive shaft occurs; and
    - the at least one connecting member and the first holder member defining a relief clearance therebetween for facilitating the deformation of the at least one connecting member.
2. A device for transmitting rotational power according to claim 1 in which the at least one elastic member is made of an elastic material able to deform and to be released from at least one of the first and second holder members when a relative rotation between the pulley and drive shaft occurs.
3. A device for transmitting a rotational power according to claim 2 in which the first holder member defines a peripheral surface, the peripheral surface of the first holder being substantially complemen-

tary to the outer peripheral surface of the elastic member; and

the second holder member defines a peripheral surface, the peripheral surface of the second holder being substantially complementary to the inner peripheral surface of the elastic member;

the first and second holder members radially cooperating with each other to circumferentially hold the at least one elastic member during normal operation to transmit the rotation, and being disconnected by the deformation of the at least one elastic member when a relative rotation between the pulley and drive shaft occurs.

4. A device for transmitting a rotational power according to claim 3 in which at least one of the first and second holder members defines a peripheral surface with a plurality of outwardly convex and concave portions alternatively arranged along at least one of the outer and the inner periphery.
5. A device for transmitting a rotational power according to claim 1 in which at least one of the first and second holder members defines a peripheral surface with a plurality of outwardly convex and concave portions alternatively arranged along at least one of the outer and the inner periphery.
6. A device for transmitting a rotational power according to claim 4 in which the at least one elastic member is substantially made into a ring shape.
7. A device for transmitting a rotational power according to claim 6 in which the at least one elastic member includes a base portion substantially in the form of a ring, and defines a peripheral surface with a plurality of outwardly convex and concave portions alternatively arranged along at least one of the outer and the inner periphery being substantially to complement to the peripheral configuration of at least one of the first and second holder members, the outwardly convex portions having an axial length longer than that of the base portion.
8. A device for transmitting a rotational power according to claim 6 in which the at least one elastic member includes a base portion substantially in the form of a ring, and defines a peripheral surface with a plurality of outwardly convex and concave portions alternatively arranged along at least one of the outer and the inner periphery being substantially complementary to the peripheral configuration of at least one of the first and second holder members, the outwardly convex portions having an axial length shorter than that of the base portion.
9. A device for transmitting a rotational power according to claim 6 in which the at least one elastic member includes a base portion substantially in the form

of a ring, and defines a peripheral surface with a plurality of outwardly convex and concave portions alternatively arranged along at least one of the outer and the inner periphery being substantially complementary to the peripheral configuration of at least one of the first and second holder members, the outwardly convex portions having an axial length substantially equal to that of the base portion.

10. A device for transmitting a rotational power according to claim 4 in which the at least one elastic member comprises sector members provided between the first and second holder members at angular intervals about the axis of the housing.
11. A device for transmitting a rotational power according to claim 10 in which the at least one elastic member includes a base portion substantially in the form of a ring, and defines a peripheral surface with a plurality of outwardly convex and concave portions alternatively arranged along at least one of the outer and the inner periphery being substantially complementary to the peripheral configuration of at least one of the first and second holder members, the outwardly convex portions having an axial length longer than that of the base portion.
12. A device for transmitting a rotational power according to claim 10 in which the at least one elastic member includes a base portion substantially in the form of a ring, and defines a peripheral surface with a plurality of outwardly convex and concave portions alternatively arranged along at least one of the outer and the inner periphery being substantially complementary to the peripheral configuration of at least one of the first and second holder members, the outwardly convex portions having an axial length shorter than that of the base portion.
13. A device for transmitting a rotational power according to claim 10 in which the at least one elastic member includes a base portion substantially in the form of a ring, and defines a peripheral surface with a plurality of outwardly convex and concave portions alternatively arranged along at least one of the outer and the inner periphery being substantially complementary to the peripheral configuration of at least one of the first and second holder members, the outwardly convex portions having an axial length substantially equal to that of the base portion.

Fig. 1

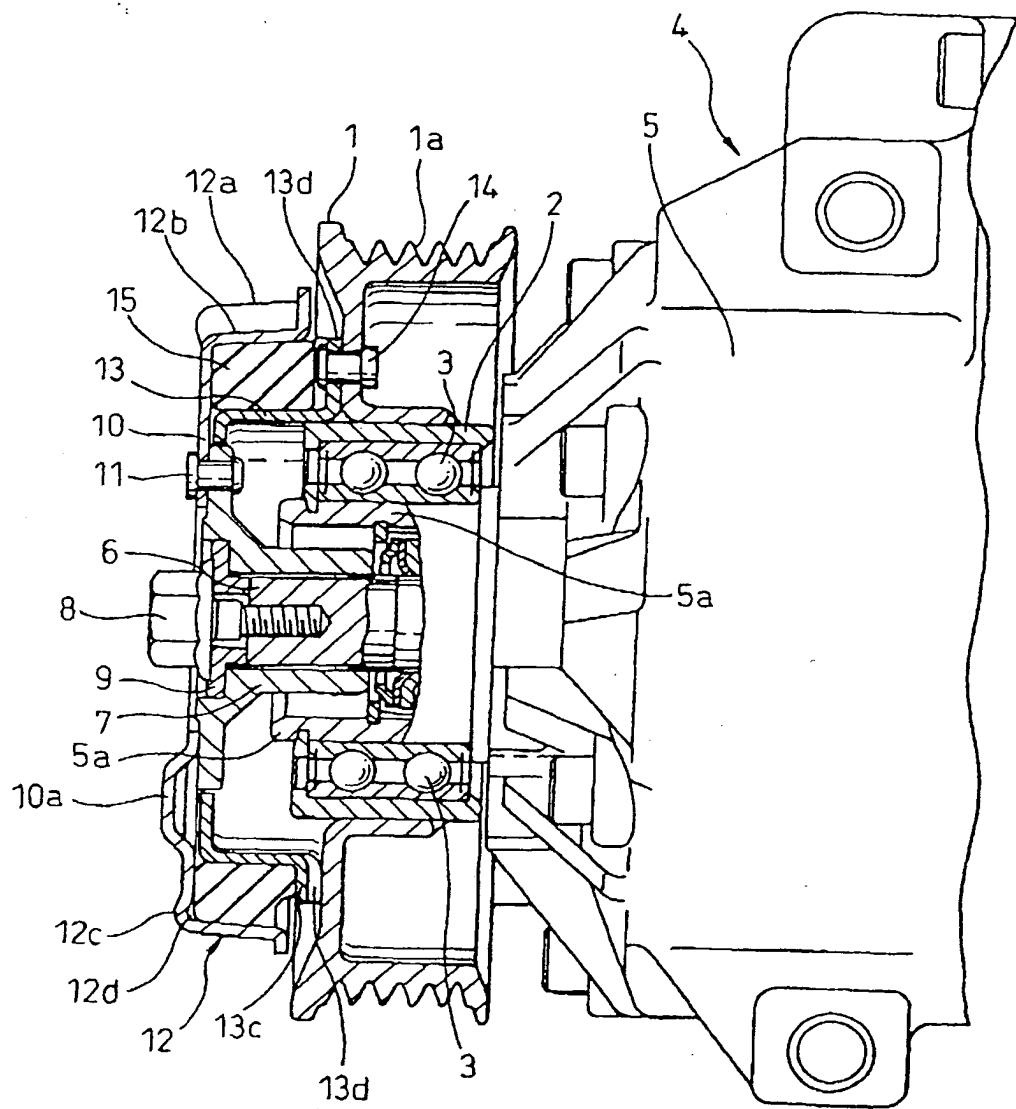


Fig.2

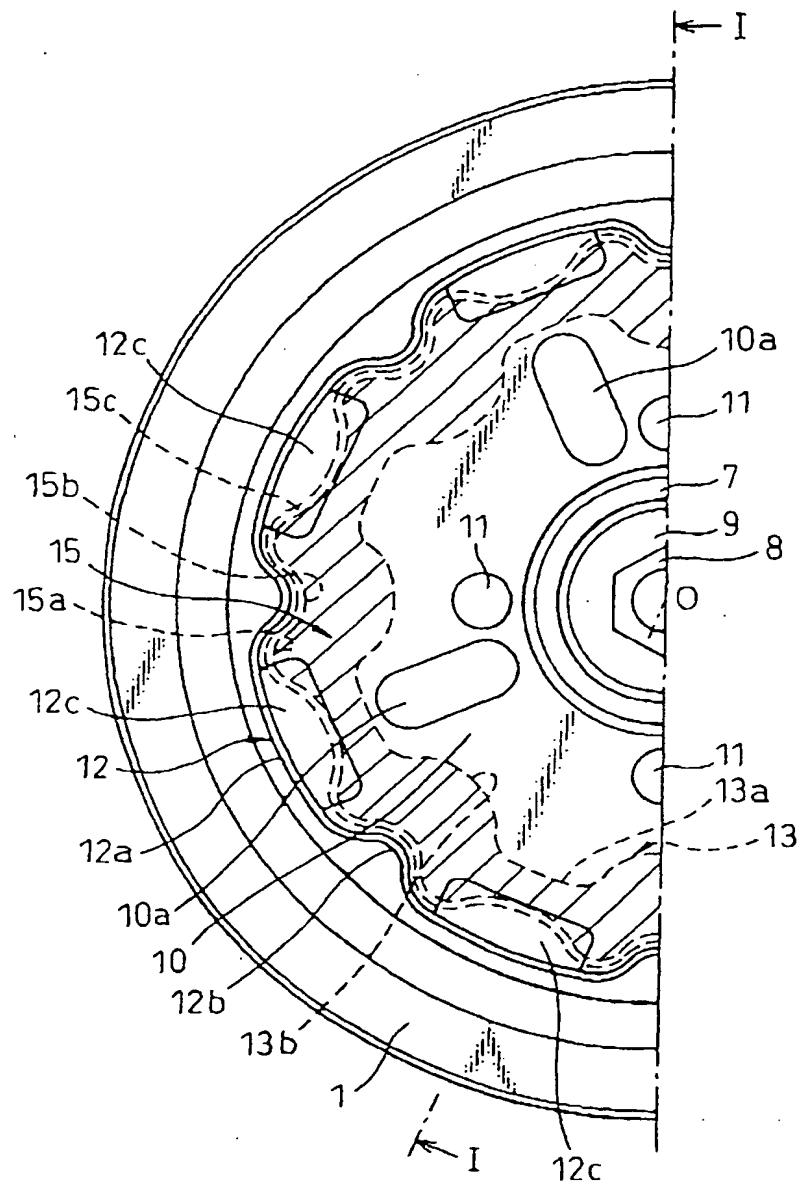


Fig. 3A

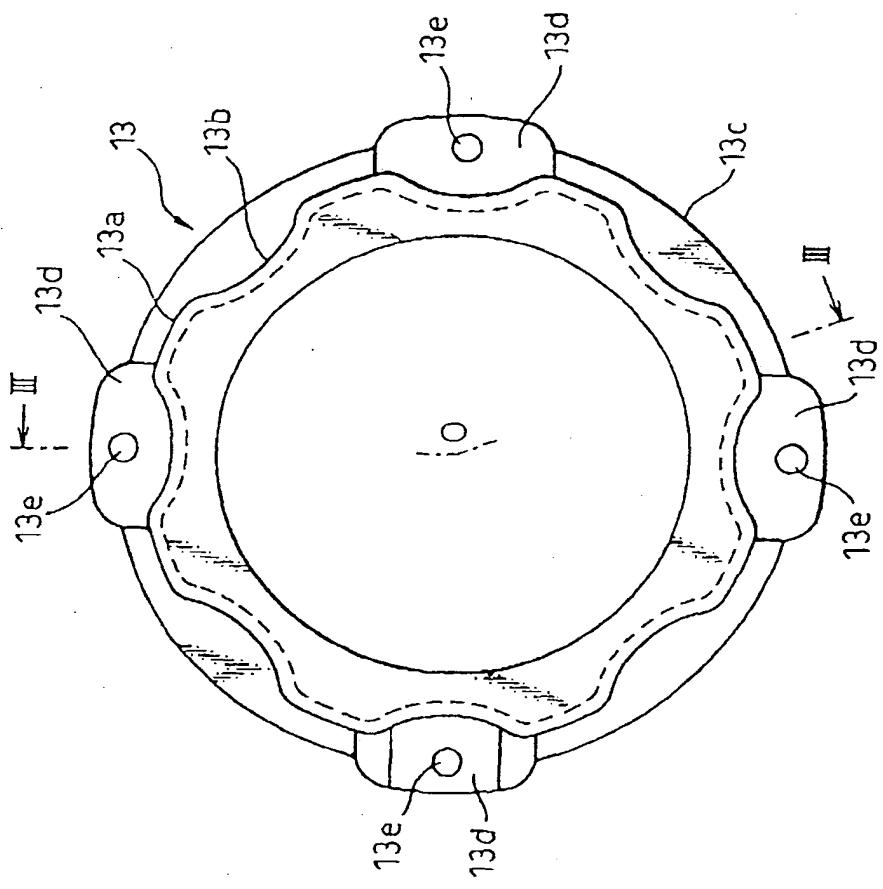


Fig. 3B

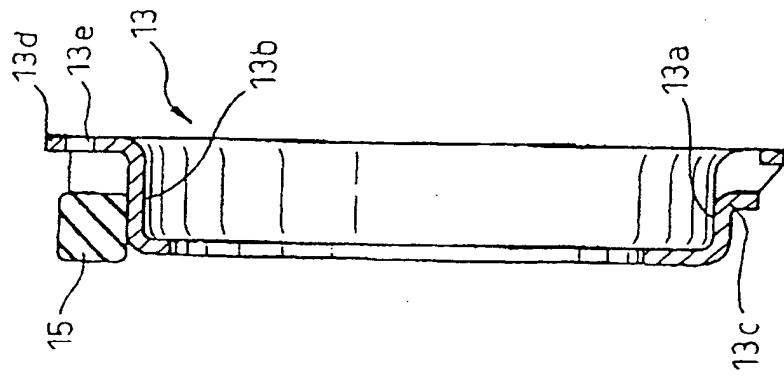


Fig. 4

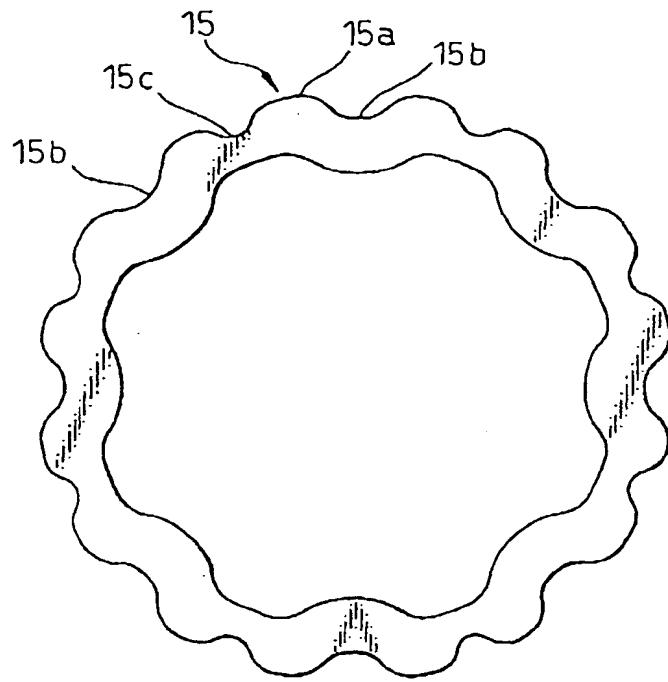


Fig. 5

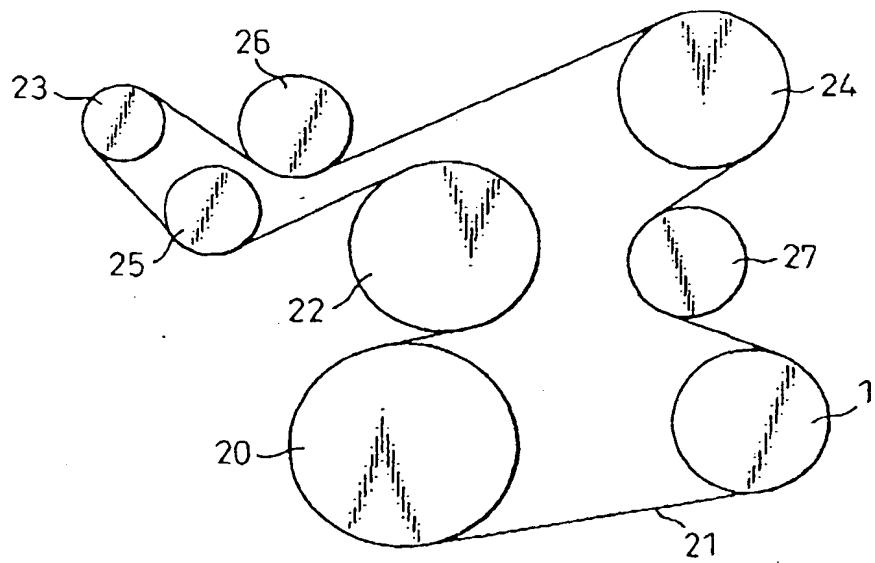


Fig. 6

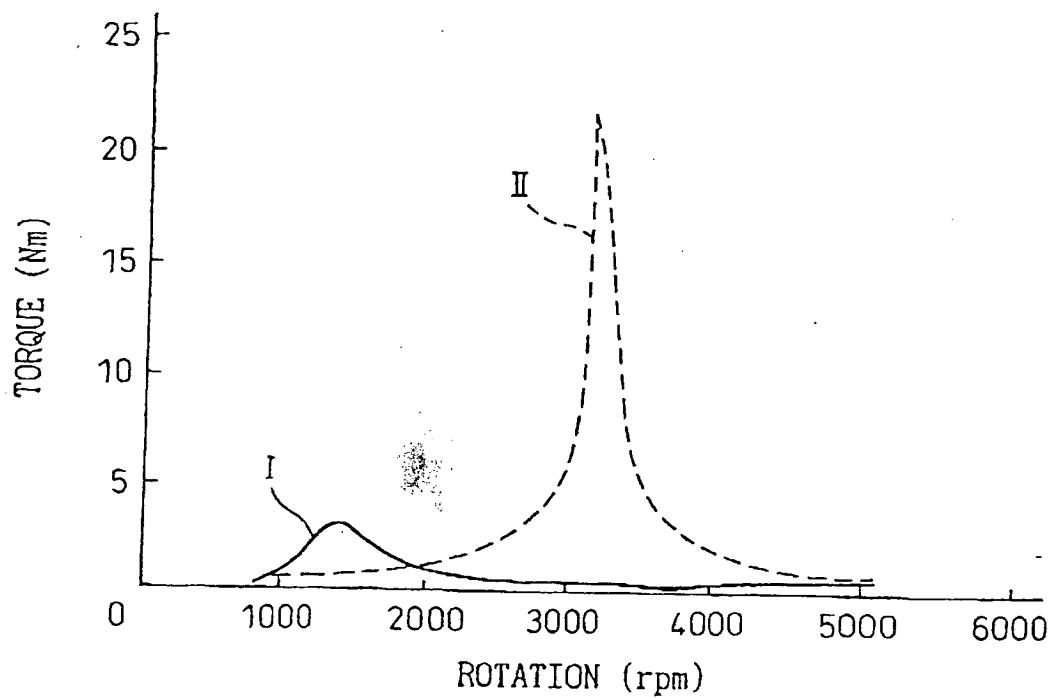


Fig. 7A

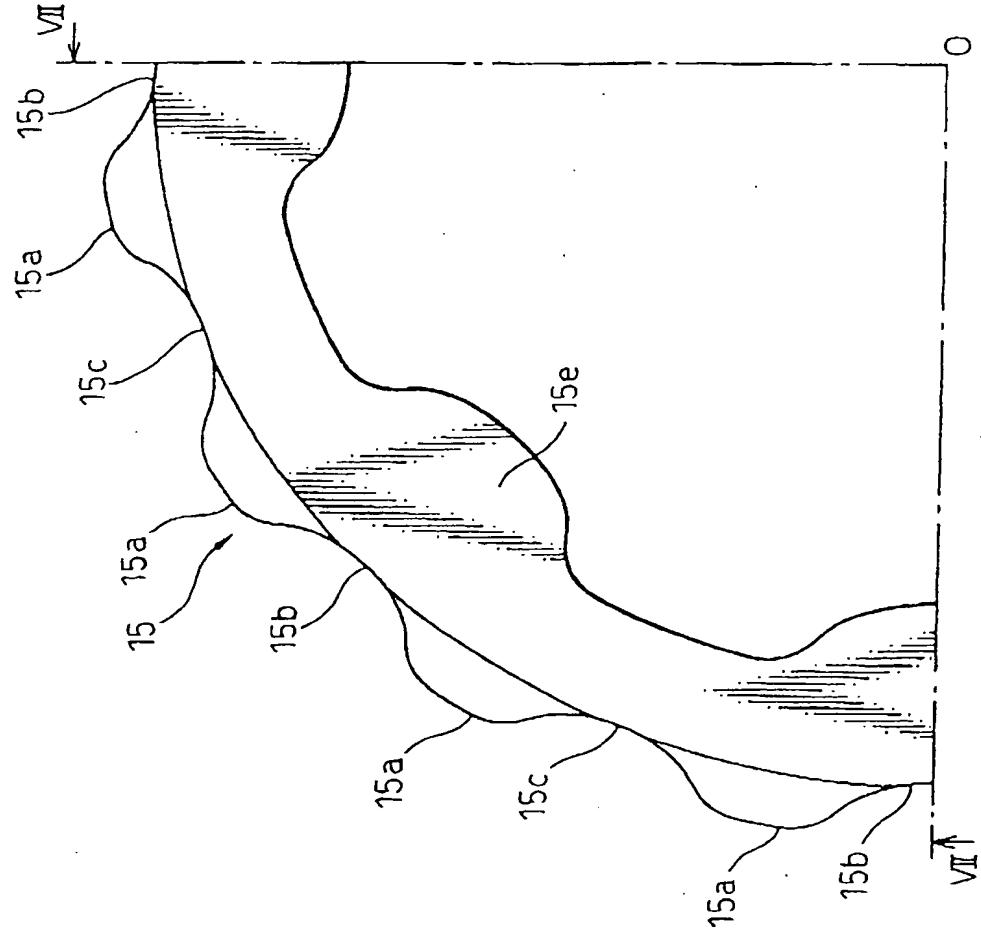


Fig. 7B

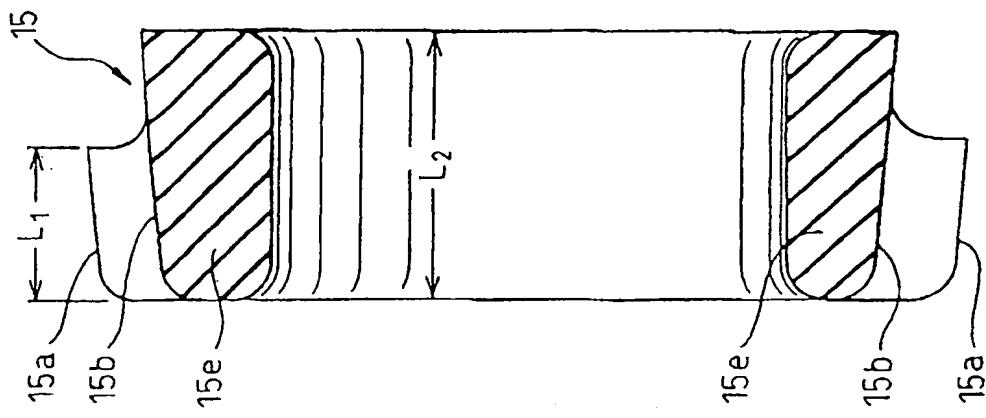


Fig. 8

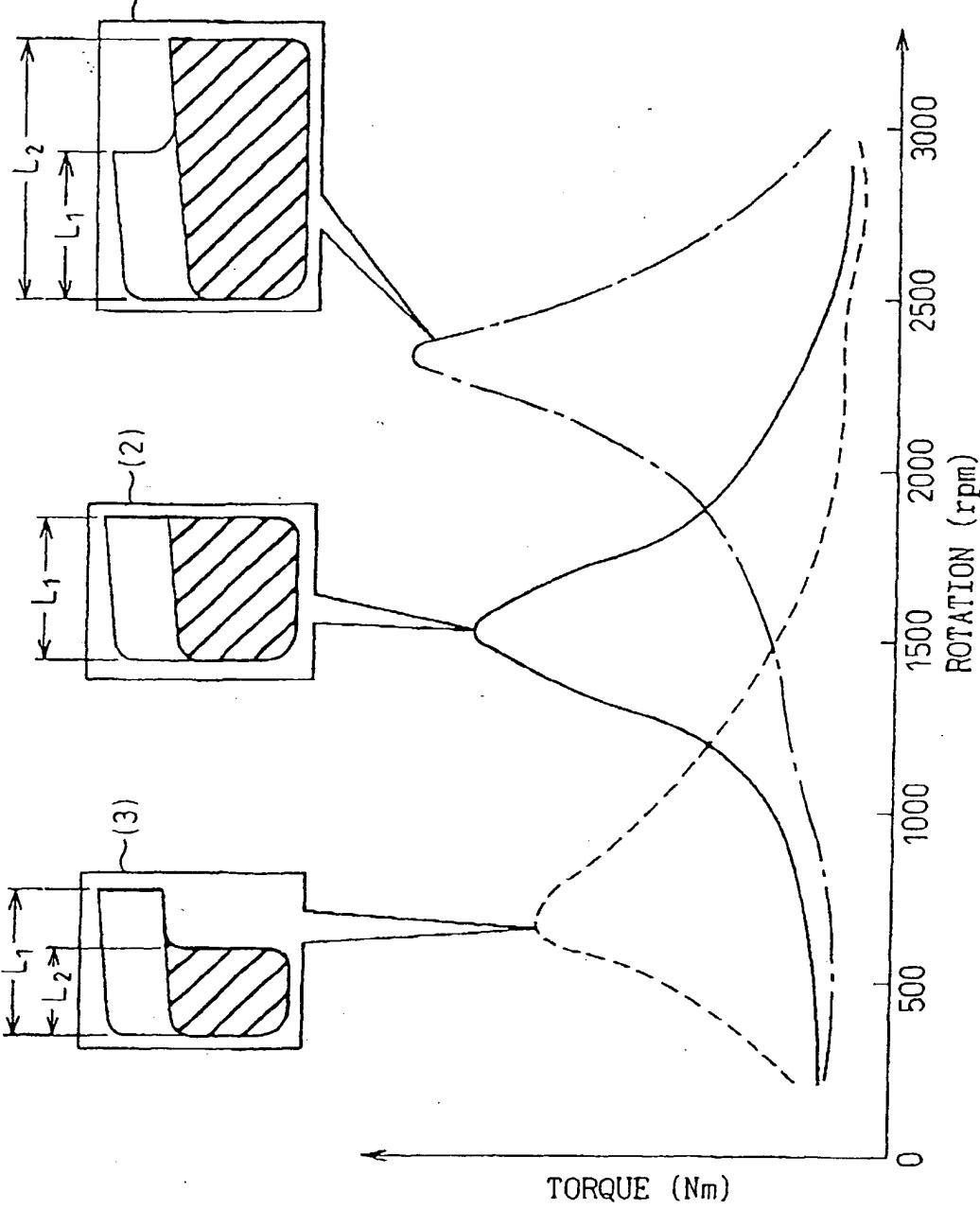
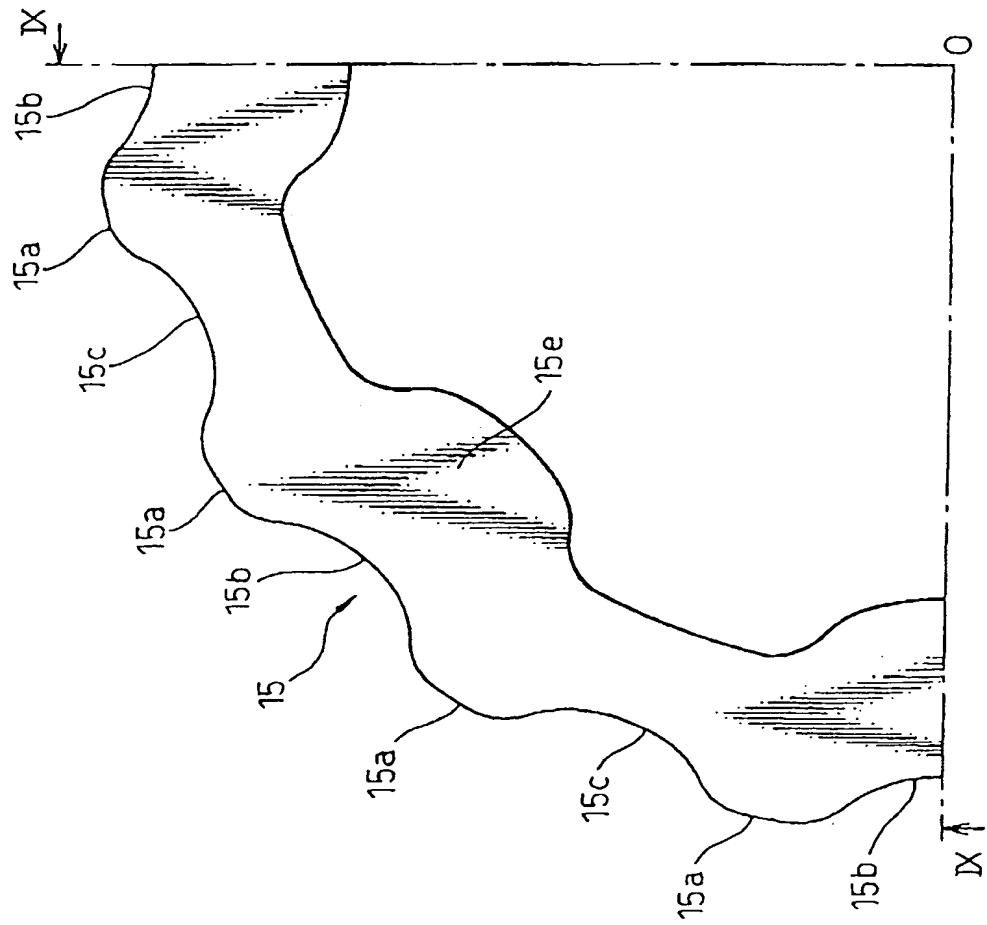


Fig. 9A



卷之三

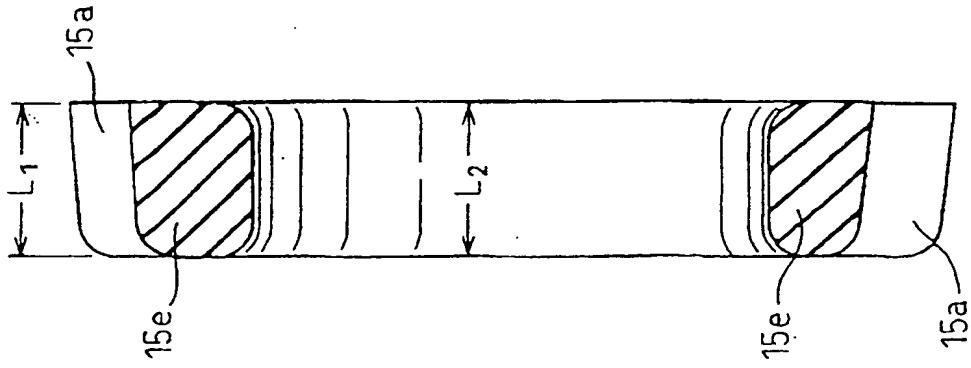


Fig. 10A

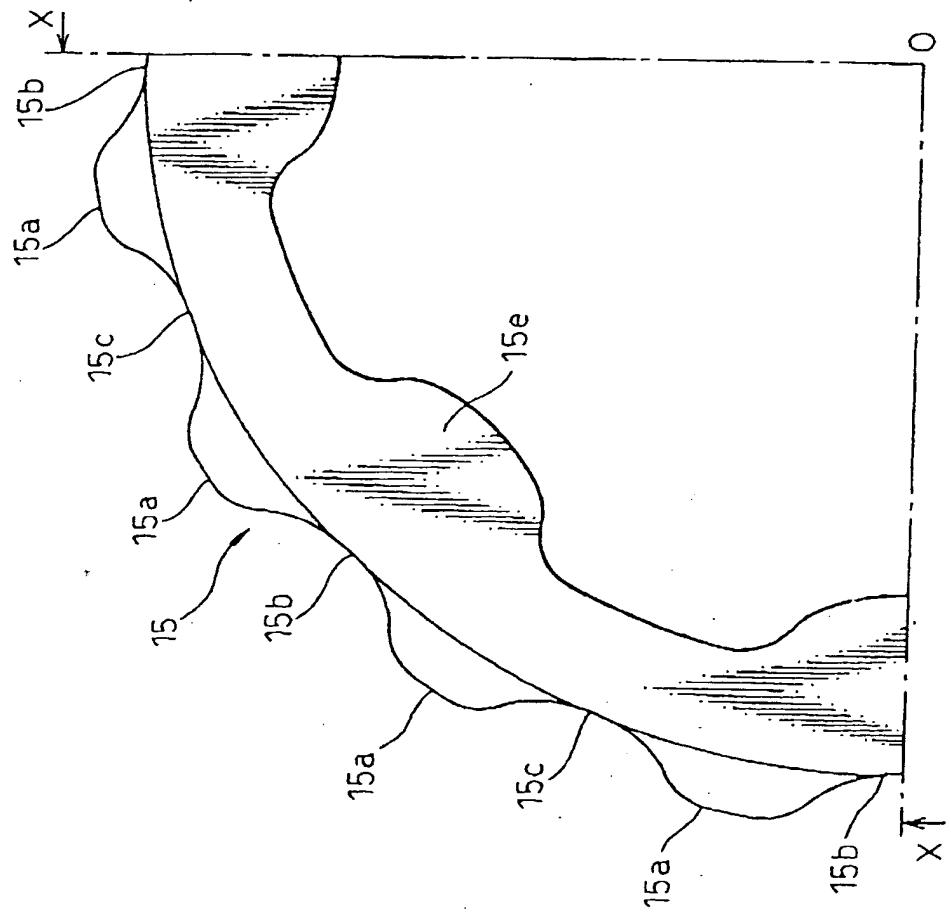


Fig. 10B

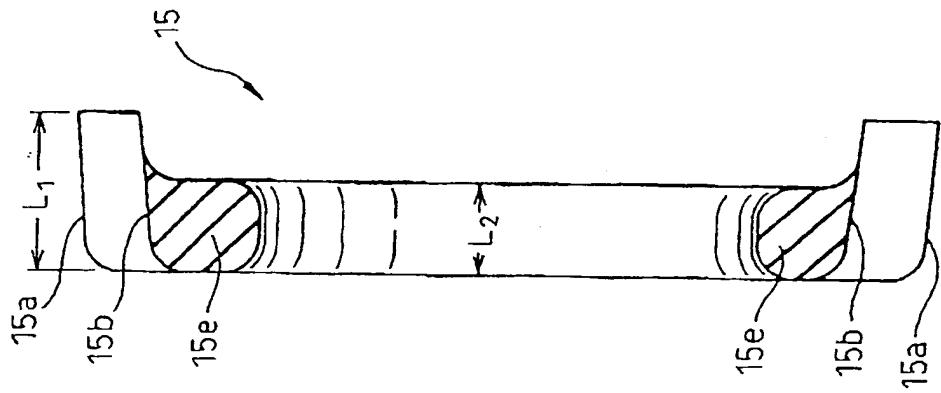


Fig. 11A

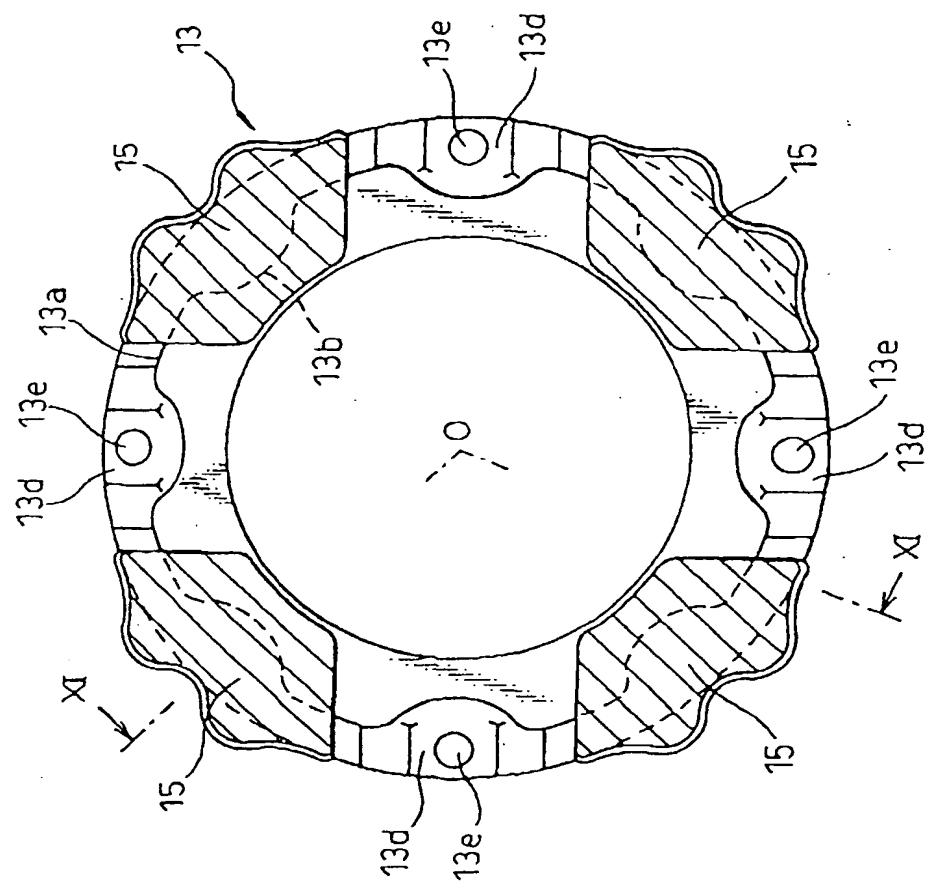


Fig. 11B

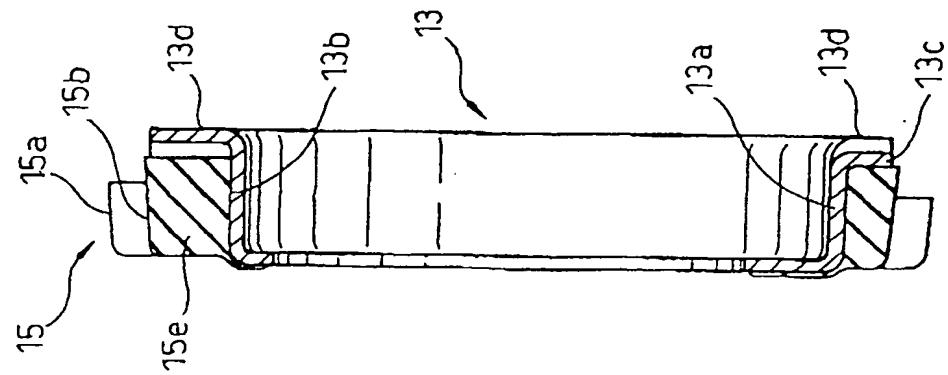


Fig. 12A

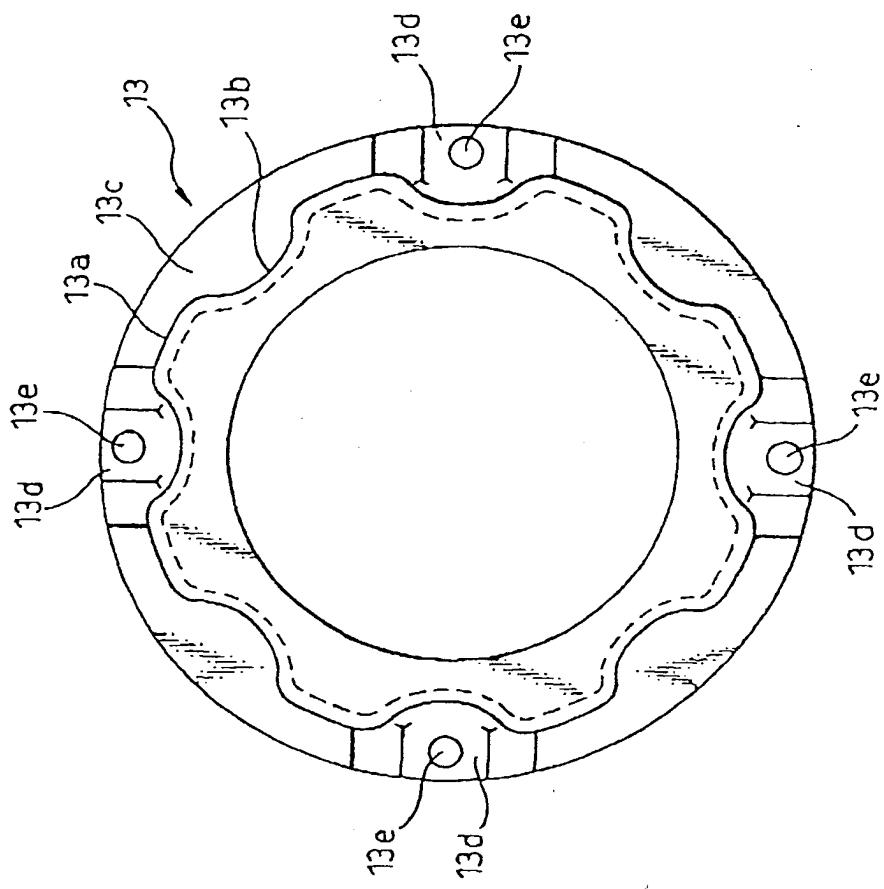


Fig. 12B

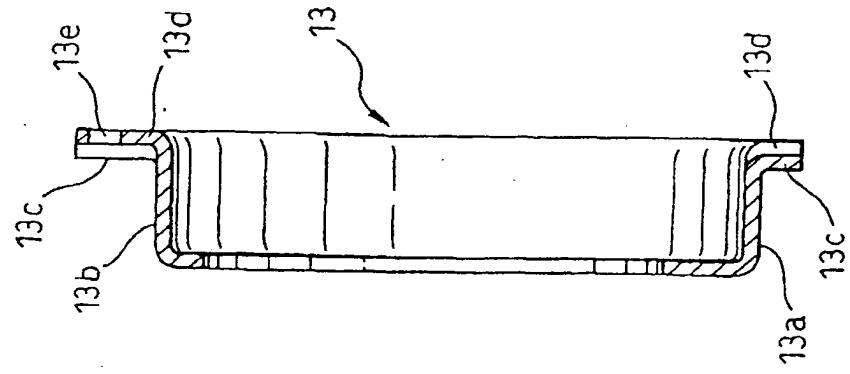


Fig. 13

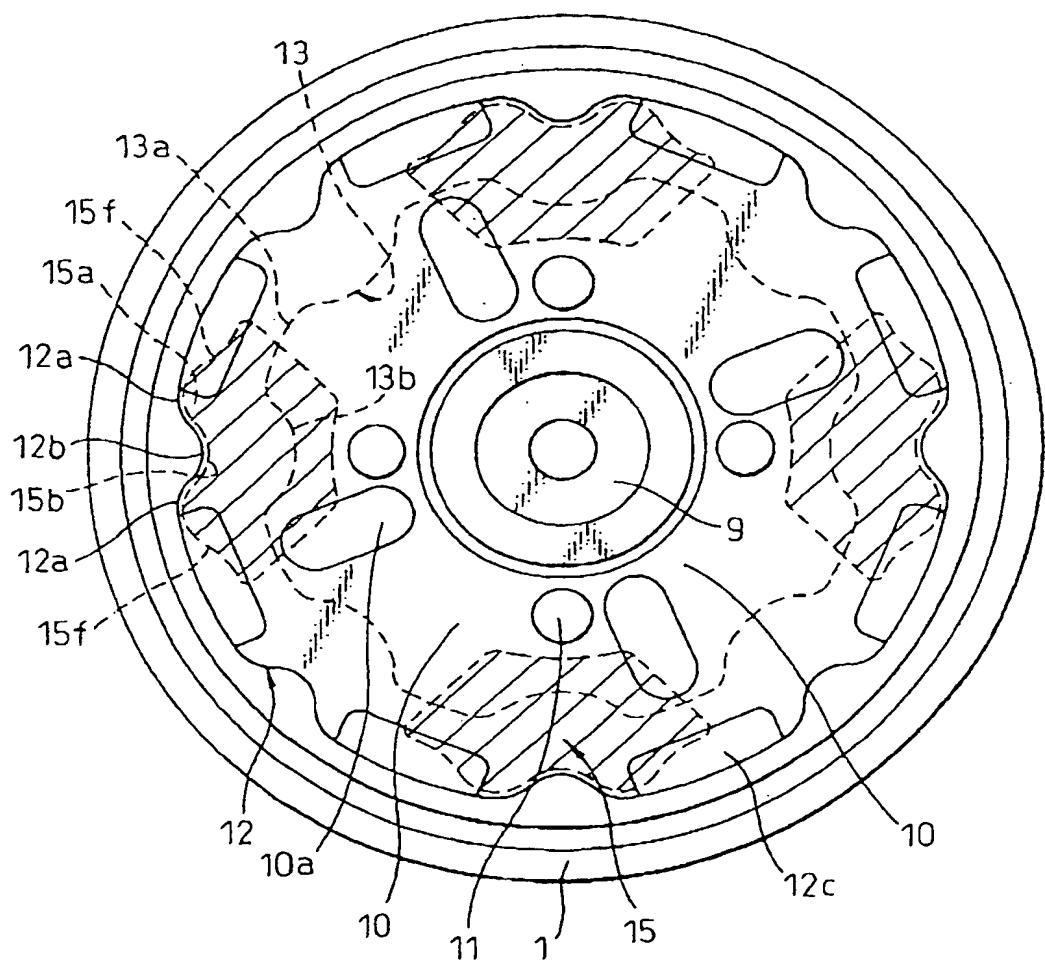
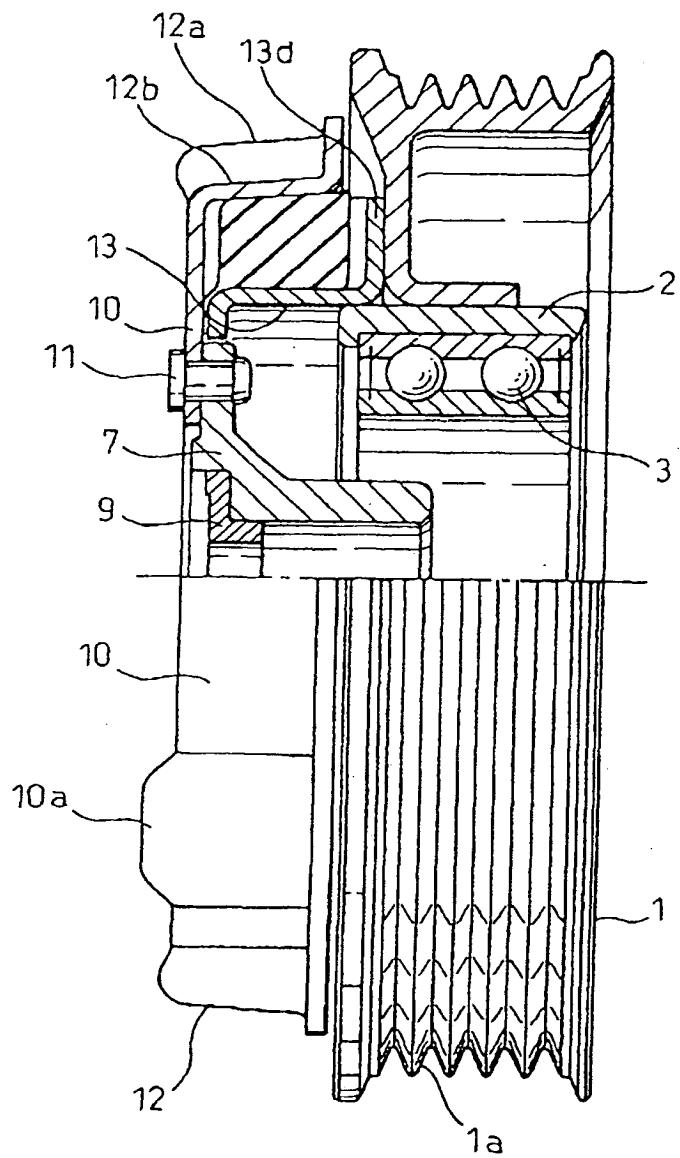


Fig. 14





European Patent  
Office

## EUROPEAN SEARCH REPORT

Application Number

EP 97 10 3250

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
P,X	EP 0 702 167 A (NIPPON DENSO CO) 20 March 1996	1-6,10	F16D7/00 F16D3/76
P,A	* column 22, line 51 - column 23, line 37; figures 13-16,31-33 *	7,9,11, 13	
Y	US 5 219 273 A (CHANG ROY Y) 15 June 1993 * abstract; figures 1-3 *	1-6,8, 10,13	
Y	FR 965 155 A (M. BEROUDIAUX) 5 September 1920 * page 2, line 95 - page 3, line 5; figures 1-6 *	1-6,8, 10,13	
A	DE 23 53 475 A (ILLINOIS TOOL WORKS) 3 October 1974 * page 4, last paragraph - page 6, paragraph 1; figures 2-4 *	1-3,6	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			F16D
<p>The present search report has been drawn up for all claims</p>			
Place of search  BERLIN	Date of completion of the search  18 June 1997	Examiner  Wiberg, S	
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			

